*LIGO Laboratory / LIGO Scientific Collaboration*

LIGO-E2300461-v1 *LIGO* 12/14/2023

Test Procedure for Squeezer Fiber Beat Note Chassis

Nutsinee Kijbunchoo, Daniel Sigg

Distribution of this document:

LIGO Scientific Collaboration

This is an internal working note

of the LIGO Laboratory.

|  |  |
| --- | --- |
| **California Institute of Technology**  **LIGO Project – MS 18-34**  **1200 E. California Blvd.**  **Pasadena, CA 91125**  Phone (626) 395-2129  Fax (626) 304-9834  E-mail: info@ligo.caltech.edu | **Massachusetts Institute of Technology**  **LIGO Project – NW22-295**  **185 Albany St**  **Cambridge, MA 02139**  Phone (617) 253-4824  Fax (617) 253-7014  E-mail: info@ligo.mit.edu |
| **LIGO Hanford Observatory**  **P.O. Box 159**  **Richland WA 99352**  Phone 509-372-8106  Fax 509-372-8137 | **LIGO Livingston Observatory**  **P.O. Box 940**  **Livingston, LA 70754**  Phone 225-686-3100  Fax 225-686-7189 |

http://www.ligo.caltech.edu/

# Testing information

|  |  |
| --- | --- |
| BOARD SERIAL  TEST DATE | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |

TESTING RESULT: **PASSED** **FAILED**

# Introduction

The following test procedure describes the test of proper operation of the Locking Fiber Beat Note Box. The Beat Box produces the locking signal for the squeezer TTFSS that stabilizes SQZ laser to the PSL. The goal of this procedure is to see that the unit has a reasonable power splitting within the box and a reasonable 160 MHz beat note output.

# Test Equipment

In order to simulate the beat between the SQZ laser (0 Hz offset) and the sample light from the PSL (160MHz offset) we utilize an ALS Fiber Distribution Box [D1200136-V2](https://dcc.ligo.org/DocDB/0086/D1200136/002/D1200136-v2.pdf) that has a 160MHz AOM built in.

1. ALS Fiber Distribution Box. Make sure it's V2.
2. 160 MHz Signal Generator (we used a Tektronix AFG31000)
3. 160 MHz Oscilloscope
4. RF Spectrum Analyzer
5. Two power supplies (+-24 and +-18)
6. Three DVMs
7. OPHIR Nova power meter
8. Three ThorLabs Fiber Cable APC
9. Two 1kOhm resistors
10. Four TNC to BNC adapters
11. Two BNC T adaptors
12. One BNC to N cable
13. A fiber coupled 1064nm light source

# Tests

1. **Verify the proper current draw.**

Using a bench DC supply apply ± 18 Volts to P1. Measure the current draw of the board and fill in the table below.

|  |  |  |
| --- | --- | --- |
| TEST POINT: | + 18 V | ‒ 18 V |
| Nominal current (A): | < 0.05 | <0.05 |
| Measured current (A): | \_\_\_\_\_\_\_\_\_\_ | \_\_\_\_\_\_\_\_\_\_ |

1. **Make sure the regulator outputs are within 5% of ±15V.**

Check the DC voltage at the output connectors P2, P3, P4 or P5 of the chassis power regulator [D1000217](https://dcc.ligo.org/LIGO-D1000217). Check that the front panel LEDs are on.

|  |  |  |
| --- | --- | --- |
| TEST POINT: | + 15 V | ‒ 15 V |
| Measured voltage (V): | \_\_\_\_\_\_\_\_\_\_ | \_\_\_\_\_\_\_\_\_\_ |
| Front panel LED | \_\_\_\_\_\_\_\_\_\_ | \_\_\_\_\_\_\_\_\_\_ |

1. **Power up the ALS distribution box. Insert the fiber coupled light source into the PSL mating sleeve. We recommend about 5 mW of input power.**

|  |  |
| --- | --- |
| Power going into ALS distribution box (mW): | \_\_\_\_\_\_\_\_\_\_ |
|  |  |

1. **Drive the ALS distribution box AOM with 10dBm 160MHz sine wave.**
2. **Connect Squeezer output of the ALS distribution box to the PSL input of the fiber beat box.**

|  |  |
| --- | --- |
| Measured power going into beat box PSL (mW): | \_\_\_\_\_\_\_\_\_\_ |

1. **Connect ALS distribution box Sample output to the fiber beat box Squeezer input.**

|  |  |
| --- | --- |
| Measured power going into beat box Squeezer (mW): | \_\_\_\_\_\_\_\_\_\_ |

1. **Measure the laser power going into the SM05PD1A diodes**

|  |  |
| --- | --- |
| PSL MON Power (mW): | \_\_\_\_\_\_\_\_\_\_ |
| Squeezer Power (mW): | \_\_\_\_\_\_\_\_\_\_ |

1. **At the PSL MON and Squeezer MON, connect a 1kOhm resistors in parallel, measure the voltage at each port.**

|  |  |
| --- | --- |
| PSL MON (mV): | \_\_\_\_\_\_\_\_\_\_ |
| Squeezer MON (mV): | \_\_\_\_\_\_\_\_\_\_ |

1. **Convert voltage measured in 8) to current, use the current and input power from 7) to calibrate each diode responsivity.**

|  |  |
| --- | --- |
| Expected Responsivity (A/W) | ~0.3 |
| PSL MON diode calculated Responsivity (A/W) | \_\_\_\_\_\_\_ |
| Squeezer MON diode calculated Responsivity (A/W) | \_\_\_\_\_\_\_ |

1. **Measure power going into Newport 1611**

|  |  |
| --- | --- |
| Power going into Newport 1611 diode (mW): | \_\_\_\_\_\_\_\_\_\_ |

1. **Measure voltage at Beat Note DC**

|  |  |
| --- | --- |
| Beat Note DC (mV): | \_\_\_\_\_\_\_\_\_\_ |

1. **Using 10kOhm transimpedance, calculate Newport 1611 responsivity from 10) and 11).**

|  |  |
| --- | --- |
| Expected Responsivity (A/W) | ~0.75 |
| Newport 1611 calculated Responsivity (A/W) | \_\_\_\_\_\_\_ |

1. **Look at Beat Note AC on an RF scope to see if you have 160MHz beat note output. Wiggle the fiber around and record the maximum amount of beat note observed.**

|  |  |
| --- | --- |
| 160MHz readout on the oscilloscope (Vpk-pk): | \_\_\_\_\_\_\_\_\_\_ |
| 160MHz readout on the RF spectrum analyzer (dBm): | \_\_\_\_\_\_\_\_\_\_ |
|  |  |

1. **Unplug one input fiber at a time, write down how much is left on the beat note DC.**

|  |  |  |  |
| --- | --- | --- | --- |
| Beat Note DC with PSL unplugged (mV): | \_\_\_\_\_\_\_\_\_\_ | SQZ MON (mV): | \_\_\_\_\_\_\_\_\_\_ |
| Beat Note DC with SQZ unplugged (mV): | \_\_\_\_\_\_\_\_\_\_ | PSL MON (mV): | \_\_\_\_\_\_\_\_\_\_ |

1. **Unplug all the inputs to measure the 1611 dark noise**

|  |  |
| --- | --- |
| Beat Note DC with input light source unplugged (mV) | \_\_\_\_\_\_\_\_\_\_ |

**Using responsivity in 12), calculate how much light from PSL and SQZ is going into the 1611**

|  |  |
| --- | --- |
| 1611 PSL (mW) | \_\_\_\_\_\_\_\_\_\_ |
| 1611 Squeezer (mW) | \_\_\_\_\_\_\_\_\_\_ |

**Using responsivity in 9), calculate how much light from PSL and SQZ is going into each SM05PD1A from 14)**

|  |  |
| --- | --- |
| PSL MON (mW) | \_\_\_\_\_\_\_\_\_\_ |
| Squeezer MON (mW) | \_\_\_\_\_\_\_\_\_\_ |

|  |  |
| --- | --- |
| **1611 PSL/PSL MON Power Ratio** | **1161 Squeezer/Squeezer MON Power Ratio** |
|  |  |